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INVITED EDITORIAL

Complexities of science and politics

The paper "The effects of annual widespread badger culls on cattle tuberculosis following the cessation of culling" by Jenkins, Woodroffe, and Donnelly (*Int J Infect Dis* 2008;**12**: [doi:10.1016/j.ijid.2008.04.001]) adds a further interesting twist to what is already one of the most thought-provoking epidemic studies of recent years — the UK government commissioned Randomised Badger Culling Trial (RBCT), aimed at assessing potential strategies for controlling bovine TB in cattle.

In a recent interview, the former UK Chief Scientific Adviser David King repeated his view that "since trials proved that cattle got TB from badgers, a badger cull was advisable".[1] This attitude represents a backward step of 30 years. It was precisely because this simple logic had failed — culling badgers over a 25-year period had failed to check the spread of the disease — that the RBCT was set up in 1998.

The disease situation is complex, with the two interacting populations of cattle (difficult to diagnose) and badgers (difficult to count); a variety of possible routes of transmission between them, of unknown relative importance; and a range of possible control strategies, including cattle testing, movement controls, biosecurity, and vaccination (of either or both species), as well as the badger culling on which the trials focused.

In contrast, the experimental setup was one of classical statistical simplicity — a randomized trial comparing three strategies, each implemented in 10 areas — though necessarily on a large scale: 5 years of experiment on 30 areas each of 100 km^2, at a cost of over £30 million (GBP). Because of the controversy surrounding badger culling, an independent scientific group (ISG) was set up to oversee the RBCT and analyze its results, the specifically statistical work being overseen by Sir David Cox and Christl Donnelly.

The key results were surprising to believers in simple mathematical models, though less so to ecologists. It was found that the reactive strategy, of localized badger culling whenever a new herd of cattle was found to be infected, had a significant detrimental effect, increasing disease incidence. The proactive strategy, in which the badger population over a whole 100 km^2 trial area was kept at as low as feasible a level by culling, had a beneficial effect within the trial area, but a significant detrimental effect just outside the area. Also, the proportion of infected badgers increased within the proactive trial areas, despite the population density being much lowered. All these detrimental effects are well explained by the hypothesis that culling disrupts the badgers' territorial structure, causing them to disperse more widely and make more infectious contacts, a hypothesis that has been supported by detailed studies using marked baits.

The ISG's final report in 2007[2] concluded that only the proactive strategy could have a beneficial effect, and that only if carried out to a high standard over an area of at least several hundred square kilometres. Further, the cost of this would be an order of magnitude higher than the benefit, so they concluded that "badger culling cannot meaningfully contribute to the control of cattle TB in Britain". In coming to this view, the ISG took account of the existence of alternative control strategies; indeed work by Cox et al.[3] estimated that the reproductive ratio of the disease needs only to be decreased by about 10%, which should be achievable by a variety of control measures, for example by increasing test frequency.

So much for the science. The ISG's report was then subjected to a brief review[4,5] by the then Chief Scientific Adviser, Sir David King, together with an 'expert group' — expert indeed on the biological side, but inadequate on the statistical or epidemic modeling side vital to assessing the ISG's work. That this review of the long considered advice of a distinguished and independent expert group took place at all is a matter of concern. It might have been justified if it had taken a wider remit, considering alternative control strategies and their costs, but instead it took a narrower remit, ignoring economics. Also, worst of all, this review took place in secret, without any contact with the ISG that might have allowed its half-baked analysis to be discussed and improved before it was taken out of the oven.

Such behaviour is a serious deterrent to good scientists from taking the time to work with and advise government. The basic ingredients for science-based policy must be independence and trust; those who give their time must feel that if their advice is not taken, it is either for scientific reasons, which they have opportunity to discuss, or for reasons beyond their remit, perhaps social or political.

Fortunately on this occasion a cross-party group of politicians provided what the Chief Scientific Adviser could not — a balanced review of the ISG's advice in the wider context. The parliamentary Select Committee on Environment, Food and Rural Affairs, after taking evidence from

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the ISG, David King, and others, came out with a report in February 2008.[6] This report, while allowing that under rigorously defined conditions badger culling might contribute, recommended that priority be given to a range of other control options. Following this, the Minister, Hilary Benn, announced in July 2008[7] that the government would not be allowing badger culling, instead setting early target dates for vaccines for both cattle and badgers, and seeking to work with farmers on tighter cattle controls and biosecurity.

Against this background, Jenkins et al.'s new paper provides an intriguing twist. They have followed up disease incidence after the culling stopped. It might have been feared that the situation would have deteriorated, with a perturbed population no longer kept down by culling. Instead, they find that, over the first year or two after the trial ended, the beneficial effect increased within the proactive trial areas, while the detrimental effect just outside them was reversed. The explanation is perhaps that the perturbed behaviour is ceasing quite quickly, with territorial behaviour restored to normal, while the population is still well below its original level. If this is correct, one might expect the beneficial effect to decay until the trial areas are no different from their surroundings once the badger population level is back to normal, which might take of the order of 10 years. That would give a considerable improvement in the cost—benefit ratio of proactive culling, though probably not enough to make it economically attractive; it should also be noted that the benefits are delayed, being greatest more than 5 years after culling starts.

It is to be hoped that more interesting results will emerge as the follow-up studies continue. Opportunities to conduct epidemiological experiments on such a grand scale are necessarily rare. Given the complexities of multi-host diseases, the RBCT would have been well worthwhile if it had just confirmed what was expected. Its unexpected results are part of the excitement of science, as is the aspect that it probably raises more interesting questions than it has solved. It should inform and stimulate research on many other multi-population diseases.

Conflict of interest

The author was the Independent Statistical Auditor to the RBCT, a position that was paid (as consulting fees) by DEFRA.

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